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Contribution of Cattellian Personality Instruments

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Raymond B. Cattell, PhD., DSc (London) was ranked among the top 10 most highly cited psychologists of the 20th century (along with Freud, Piaget, Eysenck, and Skinner), as indexed in the peer-reviewed psychological journal literature (Haggbloom et al., 2002, p. 142). Over the span of more than half a century, Cattell undertook an extensive programmatic series of empirical research studies into the taxonomy of psychological structure (across the domains of intellectual abilities, normal and abnormal personality traits, dynamic (motivation) traits, and transitory mood states). Subsequently, a wide range of functional multidimensional psychological testing instruments was constructed (see Cattell, 1986d; Cattell & Johnson, 1986; Smith, 1988) to measure the factor-analytically derived constructs. The major personality instruments constructed within the *Cattellian School* included the *Sixteen Personality Questionnaire* or 16PF (Birkett-Cattell, 1989; Cattell, 1986g, 1994; Cattell & Krug, 1986; Cattell & H. Cattell, 1995; H. Cattell, 2001, 2004; H. Cattell & Schuerger, 2003; Conn & Rieke, 1994), the *High School Personality Questionnaire* or HSPQ (Cattell & M. Cattell, 1975)—(as well as its more recent version, the *Adolescent Personality Questionnaire* or APQ),

the *Children's Personality Questionnaire* or CPQ (Porter & Cattell, 1985), the *Early School Personality Questionnaire* or ESPQ (Coan & Cattell, 1959), the *Preschool Personality Questionnaire* or PSPQ (Lichtenstein, et al., 1986; Dreger et al., 1995), the *Central Trait-State Kit* or CTS (Barton & Cattell, 1981; Barton, 1985b), the *Objective-Analytic Battery* or OAB (Cattell & Schuerger, 1978; Schuerger, 1986), and the *Clinical Analysis Questionnaire* or CAQ (Krug, 1980), along with its more recent version, the *PsychEval Personality Questionnaire* or PEPQ (see instruments on the *Institute for Personality and Ability Testing* website at <http://www.ipat.com>).

The highly-cited 4th edition of the 16 PF (16PF4: consists of 187 items comprising 16 primary factors (e.g., see Krug, 1981). When these 16 source traits were intercorrelated and subjected to factor analysis, several broad second-stratum dimensions were derived (see Boyle, 2006, for a summary). Scale reliabilities (including dependability coefficients, stability coefficients, and equivalence coefficients), as well as direct and indirect validities of the full 16PF and some combined forms may all be obtained from the relevant Technical Manual (e.g., for the more recent 16 PF 5th edition or 16PF5; see Conn & Rieke 1994). There is also available from the same sources much data on regression coefficients to predict a wide variety of criteria such as achievement, accident proneness, leadership, and so on. The 16PF (and CAQ/PEPQ) instruments are often used in a “negative selection” mode, whereby instead of attempting to make positive predictions about future performance in specific situations, the instruments are used to exclude from the selection process “at risk” individuals who have obtained extreme scores (i.e., a sten of 10) on specific trait scales (especially the psychopathological trait dimensions measured in Part 2 of the CAQ/PEPQ).

The Cattellian personality questionnaires measure primary source traits at different age levels (16PF

for adults, the HSPQ/APQ for adolescents, as well as the CPQ, ESPQ, and PSPQ for children of various age groups). Each of these Q-data instruments takes roughly up to one hour to administer, and except for the PSPQ, there is a standard questionnaire form together with an answer sheet that can be computer scored. These instruments can be administered either in an individual or a group setting. A complete listing of the factors measured in the 16PF using popular and professional labels is shown in Johnson (1986, p. 221). The personality scales for the primary factors in younger children, such as the ESPQ and PSPQ, do not cover quite as many factors as at the adult level. For example, the HSPQ drops down from 16 to 14 factors. This reflects the developmental differentiation that occurs in personality structure, and it also recognizes that some factors may be larger and more formed in childhood and others in adult life (Barton, 1986c). Cross-validation of the factor structures from numerous cross-cultural studies of the 16PF and HSPQ (e.g., Cattell & Johnson, 1986; Cattell et al., 1983) has contributed greatly to our knowledge about the universality of human personality structure.

More specifically, the 16PF has the advantages of having been (1) factored to meaningful simple structure source traits; (2) permitting scoring of second-stratum factors; (3) having been cross-validated in its standardization and foreign-language translations; (4) having corresponding downward extensions for use with teenagers and children (HSPQ/APQ, CPQ, ESPQ, and PSPQ, respectively); (5) showing strong alignment of its second-stratum Q-data factors with the first-stratum objective test (T-data) factors measured in the OAB; and (6) having empirically-derived criterion relations for major clinical syndrome categories, and for more than 40 occupational categories. Moreover, the 16PF4 has stood the test of critical scrutiny over many years and several editions of the *Test Critiques* series and the *Buros Mental Measurements Yearbooks* (MMY). The 16PF4, with the option of combined administration of its multiple parallel

forms, has the potential to exhibit very high levels of test-retest reliability (both dependability and stability).

More recently, Cattell and Cattell (1995) described the development of the new 5th edition of the 16PF, undertaken with the goal of updating and improving item content, standardizing on the current population sample, and refining the instrument psychometrically. Item selection involved an iterative process, commencing with selected items from all earlier versions of the 16PF (presumably excluding items which showed significant sex differences). Factor analyses (H.E.P. Cattell, 2001, 2004) supported the factor structure of the 16PF5 and demonstrated its continuity with earlier versions, but for this version, provided only five second-stratum factors in line with the currently popular Big Five personality dimensions and the corresponding static Five Factor Model (FFM). However, it is important to note that both Gorsuch and Cattell (1967) as well as Cattell and Nichols (1972) had previously undertaken extensive investigations into the delineation of higher-stratum Q-data personality factors. For example, from an examination of 10 separate studies, Cattell and Nichols had identified no fewer than eight second-stratum 16PF factors. Therefore, the Big Five (FFM) was seen by Cattell as being overly restrictive (Cattell, 1995). This issue has been examined independently (Boyle et al., 1995; Boyle & Saklofske, 2004), showing the inadequacy of the FFM which accounts for less than 60% of the known trait variance within the normal personality sphere alone, not including the abnormal trait domain (Boyle et al., p. 432; Boyle & Smári, 1997, 1978, 2002).

In regard to the abnormal personality trait domain, the CAQ (Krug, 1980) was developed by factoring the entire MMPI item pool, together with hundreds of additional items pertaining to various aspects of depression and psychopathology (Boyle, 1990; Boyle & Comer, 1990).

Altogether, the CAQ measures ($16 + 12 = 28$) primary source trait dimensions. The CAQ comprises two parts. Part 1 measures the 16PF normal personality factors, while Part 2 measures 12 additional (abnormal) trait factors elucidated factor-analytically. In practice, and for greater reliability, the 16 PF itself is often administered instead of Part 1 of the CAQ (which has reduced reliability with only eight items per subscale included). The difference between the two frequently used questionnaire instruments for clinical diagnosis--the MMPI and the CAQ--is that the former was constructed to separate superficial syndrome types (such as the DSM-IV recognizes), whereas the CAQ measures underlying source traits. The CAQ can and does permit type classifications, but it does so through first getting profiles on the functionally unitary traits and then classifying by similarities of profiles.

Instead of operating with both primary and secondary traits, as in the 16 PF, HSPQ, CAQ, etc., permitting *depth psychometry*, many psychologists tend to use *either* primary *or* secondary trait scores. At the first-stratum (primary) factor level, several normal personality trait factors (the first 16 of which were included in the 16PF), along with 12 abnormal (psychopathological) trait dimensions have been elucidated, which together account for most of the known normal and abnormal personality trait variance. The largest and most useful second-stratum factors are also measured via the *Central Trait-State Kit* or CTS (Barton, 1985b). There are advantages in having a *family* of instruments aimed at the same trait personality trait structures across developmental ages, and also checked in structure and standardized cross-culturally.

Nine Parameter Model of Psychological Assessment

As well as providing a detailed description of the various personality assessment instruments from the Cattellian laboratory, we also discuss these measures within the framework of a nine

parameter model of psychological assessment shown in Figure 1 below (Barton, 1985a). As well as providing a multidimensional definition of psychological assessment in line with Boyle (1991a), Eysenck (1997), as well as Eysenck and Eysenk, (1985), the nine-parameter model also can be used for taxonomic classification of psychological instruments themselves (Barton, 1986c). By identifying the Cattellian instruments within the framework of this model one can see the breadth of coverage of each personality instrument, as well as highlighting those areas that are not presently covered.

Figure 1: The Basic Nine Parameter Model

Barton's (1985a) nine-parameter model does not attempt to address the "process" aspects of assessment (i.e., the steps which must be followed) but views assessment in terms of nine questions that must be answered in stratum to define fully the domain of psychological assessment. The nine parameters may be grouped roughly into sets of three. The first set concerns questions about WHO is being assessed (e.g., How old are they? Are they from a "normal" population or from a clinical group?). The second set is related to WHAT is being assessed (e.g., personality, cognition or motivation? Questionnaire, projective or objective test?). The third set has to do with the HOW of assessment (e.g., Do we need multiple measures? Multiple variables? On what scale will we assess: nominal, ordinal or interval?).

Parameter 1: Developmental Level

What is the appropriate developmental level at which to measure a given individual? What aspects of the developmental level should influence the choice of measures used in the assessment (e.g., language or reading level)? It is this dimension that the Cattellian *Institute for Personality and Ability Testing* (IPAT) had in mind when it designed and constructed a wide array of psychometric instruments to measure factor-analytically elucidated personality traits. While the 16PF is the instrument of choice when measuring adult personality traits (Birkett-Cattell, 1989; Boyle, 1990), the HSPQ was specifically designed for adolescents; the items on this instrument were all focused on the lifestyle and interests of the typical North American teenager. While the CPQ was intended for use with 8-12 year olds, the ESPQ was constructed for use with 6-8 year olds, and the PSPQ for use with children younger than 6 years. In the construction of these instruments it was shown empirically that different numbers of factors needed to be extracted at different age levels (Boyle et al., 2001; Cattell, 1973; Cattell & Kline, 1977). The reduced number of factors measured in the various downward extensions of the 16PF instrument (HSPQ, CPQ, ESPQ, and PSPQ) is consistent with the increasing complexity of personality structure over the early lifespan as a function of socialization and experiential learning (Cattell, 1983, 1996). Indeed, in recent years, it has become increasingly evident that personality traits are subject to change throughout the lifespan (Cattell et al., 2002; Eysenck, 1994c; Roberts et al., 2006a,b).

When items are rewritten for different age levels, can the factors they represent be considered the “same”? The construction of related instruments for various age levels has a definite advantage over a single measure since the different versions can be tailored to fit developmental levels by using items that tap personality through the differing interests and behaviours from childhood to adulthood (Cattell & Dreger, 1978; Eysenck, 1984). However, some distinct

disadvantages come to mind. The first is that developmental cutoff points for the instruments may be arbitrary. Some 16-17 year olds can readily cope with responding to the “adult” 16PF, whereas for others at 18 or 19 years of age, the HSPQ might be more suitable. Another issue that is relevant when we chose to use different questions for different age levels is that of the changing mores and fads of society. The HSPQ was constructed more than 30 years ago (see R. B. Cattell & M. D. Cattell, 1975) and the teenagers of the 21st Century have a vastly different set of potential behaviours through which they can express their personalities. If the HSPQ were to be updated today, the range of potential items would be greatly increased due to the expansion of the high technology world.

Parameter 2: Trait versus State

The major Cattellian personality instruments (OAB, 16PF, CAQ, CTS, HSPQ, CPQ, ESPQ and PSPQ) were all designed to measure relatively enduring trait dimensions. However, the state-trait distinction is an important one that must be considered in personality assessment. Cattell was perhaps the first to highlight this distinction in relation to state-trait Anxiety (see Cattell, 1986e; Cattell & Scheier, 1961). Historically, a personality trait has been defined as a set of related behaviours that remain relatively consistent over a long time period (e.g., Comrey, 1980; Eysenck, 1988, 1994a,c; Fisher & Boyle, 1997). A situationally-sensitive state on the other hand is again a set of behaviours which fluctuate from moment to moment and from day to day (i.e., over time and circumstances). Any given individual has a characteristic trait level of Anxiety (A-Trait) or Curiosity (C-Trait), but depending on the situation, may vary in the level of A-State or C-State, respectively (Boyle, 1983, 1989a). The relationship between personality traits and related emotional states has been highlighted in several empirical studies.

Thus, personality questionnaire data have been subjected to P-technique and/or differential dR-technique factor analyses revealing transitory state dimensions (e.g., Barton & Flocchini, 1985; Boyle, 1987a, 1988, 1989d; Boyle & Cattell, 1984; Cattell, 1978, 1982a; also see Boyle, 1987b, as well as Cattell & Kameoka, 1985, for a list of abnormal state dimensions derived from dR-factoring of Part 2 of the *Clinical Analysis Questionnaire* or CAQ).

The Cattellian motivation measures (cf. Cattell, 1985, 1992a), including the *Motivation Analysis Test* (MAT) at the adult level (Boyle, 1986, 1988; Boyle & Cattell, 1984, 1987; Boyle et al., 1985; Cattell, 1982b, 1985) and its downward extensions, the *School Motivation Analysis Test* (SMAT) used with adolescents (Boyle, 1989b; Boyle et al., 1988), and the experimental version of the *Children's Motivation Analysis Test* (CMAT)—(Barton et al., 1986; Boyle, 1989c; Boyle & Start, 1988) all provide objective test measures of dynamic traits that are somewhat less stable than personality traits, but relatively more stable than transitory mood-state dimensions. In addition, the *Eight State Questionnaire* or 8SQ (Curran & Cattell, 1976) measures personality variables in a state form (Barton, 1986b; Boyle, 1986, 1989d, 1991b). The 8SQ subscales are labeled: Anxiety, Stress, Depression, Regression, Fatigue, Guilt, Extraversion, and Arousal. Variables such as Anxiety or Stress have been singled out for special treatment in test development by IPAT presumably because of their high usage in clinical psychological practice (Cattell, 1987).

Parameter 3: Normal (Non-psychopathology) - Extreme (Psychopathology)

Is the individual being assessed expected to be similar to most others (i.e., within plus or minus one standard deviation or so from the mean) on the dimensions measured? If the answer to this

question is in the negative, then often it may be preferable to select other measures designed specifically for extreme scorers and which do not exhibit such high unreliability of measurement at the bottom and top ends of their scales (cf. Barton & Dreger, 1986; Cattell, 1986a). In some cases, for example in personality assessment, individuals with "extreme" scores might be administered qualitatively different scales to describe their personality structure (Barton, 1986a,c; Barton & Cattell, 1975). Parenthetically, the *Culture Fair Intelligence Tests* or CFIT (Cattell & Cattell, 1977) illustrate this parameter. Here a separate scale is available if one is measuring around the average intelligence level; another scale is designed for the below-average intelligence and a third scale concentrates on providing a score for individuals with higher than average intelligence. In the personality arena, this parameter is illustrated by the fact that the 16PF series for example measures variables within the "normal personality sphere" (Boyle, 1989e,f, 2006). Part 2 of the CAQ (Krug, 1980) however, measures the abnormal or psychopathological personality trait domain. In the case of motivation measurement, only the "normal" sphere has instruments that represent it (i.e., the MAT/SMAT/CMAT)--(see Barton et al., 1986; Boyle, 1986; Cattell, 1992a; Schuerger, 1986). Here Barton's (1985a) nine parameter model has heuristic value in suggesting that measures of "abnormal motivation" might also be constructed. Aside from their use in research studies, such measures of abnormal motivation might be useful in several applied areas of psychological practice, including, for example, clinical and forensic psychology (Barton & Wood, 1993).

Parameter 4: Domain (Field of Measurement)

What general area of mental life are we dealing with and what dimensions are needed to fully define this domain? A dictionary definition of domain is a "field of thought or action."

Here the question has to do with what kind of measures are we dealing with: personality, motivation, cognition, etc.? It is no coincidence that the Cattellian measures illustrate this parameter since we find multiple instruments published for all of the major domains. The 16PF series of instruments with its downward extensions (HSPQ, CPQ, ESPQ, and PSPQ) covers the domain of normal personality (Barton, 1986b; Barton & Dreger, 1986). Indeed, the 16PF is the most highly cited measure of normal personality and there are now five editions of this highly regarded psychometric instrument attesting to its acceptance among the mainstream psychological community (see H.E.P. Cattell, 1993, 2001, 2004; for discussion of the 16PF 5th edition). Abnormal/psychopathological personality is assessed using Part 2 of the CAQ, while the MAT/SMAT/CMAT series of objective-test instruments covers the normal motivation domain (Cattell, 1985; Sweney et al., 1986), and the 8SQ provides a quantitative assessment of several clinically important mood states derived from dR-factoring of the personality instruments. Separately, the CFIT series of objective tests (Cattell & Cattell, 1977) as well as the *Comprehensive Ability Battery* or CAB (Hakstian & Cattell, 1982) enable quantitative measurement of the domain of cognitive abilities (cf. Cattell & Horn, 1982).

Parameter 5: Media of Measurement (Method)

What are the different methods that, at least theoretically, could be used to tap and measure the dimensions of interest? By measurement media is meant the means, agencies or instruments through which data is collected for assessment purposes (Cattell, 1973, 1986b; Cattell & Nesselroade, 1988). Methods of personality measurement currently employed, including self-report questionnaires, rating scales (reports of others—see Johnson, 1986), interviews (formal/informal; structured/unstructured), naturalistic observation, experimental observation,

projective techniques, objective tests, essays, standardized self-report instruments, diaries, demographic and biographic data, and so on. Cattell (1973), as well as Cattell and Kline (1977) argued that it should be possible to identify personality traits through multiple measurement media including ratings or life-record data (L-Data), questionnaire data (Q-data), or objective test data (T-data). Choice of specific media to be used in any assessment procedure will depend on many factors such as the relative importance attached to fakeability or motivational response distortion (Cattell, 1992b), the degree to which validities and reliabilities must be demonstrably high, the diversity and scope of the assessors' practical skills, the emphasis on actual behaviours versus attitudes, and so on. In an ideal assessment situation the same (or similar) variables would be targeted using several different measurement media. A consistent pattern of results across different media would suggest high convergent validity, a fact that Campbell and Fiske (1959) have highlighted in their multi-trait, multi-method theory. The term multi-method that Campbell and Fiske used is equivalent here to the idea of multiple media (Barton, 1986a).

This assessment parameter involving choice of measurement media is a complex one that not only subsumes the issue of convergent validity but also such topics as face validity, concept validity, discriminative validity, construct validity, social desirability of items, the construction of correction scales to minimize faking (good or bad), lie scales, instruments for random marking, as well as the more sophisticated trait view theory approach (Cattell, 1979, pp. 370-372; Cattell & Krug, 1971). It is essential, therefore, that in constructing any assessment procedure that the literature on the advantages and disadvantages of a variety of measurement media be taken into account (Cattell, 1986c,f; Johnson et al., 1986).

Although the majority of Cattellian instruments involve Q-data media, much of the research that was undertaken within Cattell's laboratory at the University of Illinois also involved other kinds of measurement media. The *Objective Analytic Battery* or OAB (Cattell & Schuerger, 1978; Cattell et al., 1980; Schuerger, 1986) is the compilation of several objective tests and has been used extensively to confirm the basic personality structure in a different media from questionnaires--especially the 16PF second-stratum factors which align with first-stratum OAB trait dimensions (Boyle, 2006; Boyle & Robertson, 1989; Cattell & Birkett, 1980; Cattell & Nichols, 1972; Cattell & Schuerger, 1978; Krug & Johns, 1986). As compared with the Q-data media, it is almost impossible to fake one's responses to objective (T-data) test measures.

Parameter 6: Nomothetic (Group) - Idiographic (Individual)

Is our intention here to understand relationships within an individual (idiographic) or to be able to generalize to large groups of individuals (nomothetic)? This question helps to pinpoint more precisely exactly which measures will be used in any given assessment and has to do with the decision to utilize either group testing or individuals assessment. If the major objective of an assessment procedure is to generate or investigate nomothetic laws (relationships that hold over large groups of individuals), group instruments may be desired since they are efficient in terms of cost, time and amount of data generated. However, if idiographic knowledge (investigation of consistent relationships within a single individual) is the aim, then individual testing often will be required. The Cattellian Q-data personality instruments (16PF, CAQ, HSPQ, CPQ, ESPQ, PSPQ) have been designed to be administered either individually or in groups. The norms provided in the test manuals themselves encourage a nomothetic approach since one can

compare each individual's score to the mean scores obtained on large, representative standardization samples (Cattell, 1986c). In addition, P-technique factor analyses have often been used to identify idiographic (idiosyncratic) factors that may be unique to the individual (Cattell, 1983; Cattell & Kline, 1977; Kline, 1986).

Parameter 7: Scaling (Nominal, Ordinal, Interval)

To what extent do our measures reflect qualitative (e.g., categorical or nominal) versus quantitative (e.g., interval) measurement of the dimensions in question? Several taxonomies of scaling have been suggested by psychometrists whose major goal is the quantification of psychological measures. For example, anxiety might be assessed dichotomously through “yes or no” responses to a simple question (nominal scaling since the individual may merely be classed say as “anxious” or “not anxious”). Alternatively, anxiety might be ranked as to its degree of intensity in say, three different situations (or it might be measured on a 5-point Likert-type ordinal scale, with item responses varying from, “very anxious” to “not very anxious” (interval). Depending on the type of scale used, the assessment will have different statistical options available (see Boyle & Langley, 1989). Data collected at the nominal level, for example, lends itself to non-parametric statistical methods but not to the more powerful parametric statistical methods. Data collected at an interval level of scaling can usually be converted to an ordinal or nominal level, making available a much wider choice of statistical techniques (see Boyle & Langley, 1989). Clearly though, scaling decisions should be made in a deliberate fashion *before* any data collection is accomplished (Barton, 1986c; Cattell, 1986c).

Except for ability instruments such as the CFIT or CAB, the items on the Cattellian personality, Q-data questionnaires often measure at the categorical level and it is only when we sum across several items that we obtain a final scale score that is at the interval level. Thus, at the item level the question is often of the form "do you prefer (a) or (b)?" This is clearly at the nominal/categorical level since (a) is in no way greater or smaller than (b). If choice (a) is, for example, "going to a party" and (b) is "staying home with a book," and the choice is made for (a), this may count as a unit on an "extraversion" scale and be summed over a number of such choices. Eventually the respondent is assigned a place on an interval scale but all the individual questions required nominal choices! Parenthetically, with items on measures of abilities, the scaling situation is somewhat different. IQ test items typically have definite right and wrong answers (i.e., convergent reasoning rather than the divergent reasoning involved in tests of creativity). Nonetheless, because IQ scale units are not completely equivalent at different levels of intelligence, the IQ scale technically provides a quasi-interval level of measurement (Glass & Stanley, 1970, p. 13). This applies also to all the items measuring Factor B (intelligence) on the 16PF series of personality instruments (see Cattell & Brennan, 1985, for a discussion of methods of deriving equal interval unit scores).

Parameter 8: Multiple Variables (Multivariate Measurement)

Can we use or devise multiple measures of the same variables *within* any given medium?

Campbell and Fiske (1959) emphasized the usefulness of multi-trait multi-method (media) matrix in psychological measurement (cf. Barton, 1986a). Here we extrapolate their model to include multiple variables. For example, if we are assessing "anxiety," often it would be preferable to do so employing several measurement media, including questionnaires, interviews

and objective instruments, and also to undertake multidimensional assessment in the context of other traits such as depression, or stress (Cattell, 1986b). It would also help to have multiple measures of a psychological construct within any medium (e.g., 16PF second-stratum Anxiety/Neuroticism factor and the score on say Eysenck's Neuroticism dimension—Eysenck, 1988, 1994a,b; Eysenck & Eysenck, 1975). This arrangement would permit the estimation of convergent validity not only across media or methods but within measurement media as well. Use of multiple variables within the same measurement media will provide greater confidence in any inferential statements made about the data, since in effect, any relationships will have been multiply verified and not rest on single measures alone (Barton & Wood, 1993; Boyle, 1991a).

Parameter 9: Multiple Replications (Test-Retest Reliability)

Is the nature of personality measures selected such as to allow multiple retesting (repeated-measures design) at both short and long intervals? This parameter is important in the design of longitudinal assessments and in the demonstration of the consistency reliability properties of personality instruments. As discussed in Cattell (1973), often the same psychometric measures may be used for both short-term or immediate retesting (dependability) as well as longer-term retesting (stability). In other cases, especially when memory of items may influence subsequent responses, separate parallel forms of an instrument have to be constructed for retesting purposes (see Cattell 1986f). Since the *process* of assessment ideally involves future retesting or assessments, then it is easy to see how selection of measures must incorporate criteria that ensure that retesting is possible in the absence of methodological problems (Barton, 1986b,c).

Uses of the Nine Parameter Model

1. *As a classification system or taxonomy.* It is hoped that the model described above (Barton, 1985a) will be found useful as a means of both classifying existing personality instruments and assessment methods and also as a stimulant to the creation of new measures that as yet only exist in theory. For example, the model suggests the new concepts of state motivation and state cognition. Few, if any existing instruments exist that represent these ideas and the usefulness of such concepts can hardly be estimated until such measurement instruments are constructed and empirical studies undertaken (Barton, 1986a,c). In using the nine-parameter model to classify existing psychometric instruments, it is anticipated that the parameters suggested in the model will provide a context or perspective which will help to emphasize the strengths and weaknesses of specific instruments, and thus encourage modifications and further changes in the design of personality instruments (as well as other categories of psychometric instruments).

2. *As part of the definition of psychological assessment.* Earlier, psychological assessment was defined in terms that included decisions, data collection and procedures. This model is intended, in part, to further clarify how the data is to be collected, what data is to be collected and what attributes of the testee must be considered. The other components of the definition involving decision making criteria and procedures are discussed in Barton (1985a).

3. *As an aid in the critical analysis of instruments.* The series of parameters in the model may be used as a checklist of questions to be asked of any instrument to be scrutinized. For example, it may be useful to identify the three-dimensional "position" of a specific instrument, say Cattell's 16 PF, within the model and then use the parameter questions to determine its

strengths and weaknesses (Barton, 1986c). It is remarkable how much focused criticism, positive and negative, can be generated by using the model as a framework for critical analysis of a single instrument.

Other Aspects of Personality Assessment by Questionnaire

Omnibus instruments such as the Cattellian personality questionnaires, which within an hour or less, cover 12 to 16 personality dimensions, cannot have the validity and reliability levels of say an intelligence test that devotes to the measurement of one factor as much time as these do to a dozen or more factors. However, to meet the needs of the researcher or practitioner who requires high reliabilities, these instruments are constructed with several parallel forms. For example, the 16 PF (4th ed.) has no fewer than six parallel forms, namely, A, B, C, D, E, and F. In stratum to ensure adequate reliability, Cattell has always recommended that at least two forms of the 16 PF (Forms A + B or Forms C + D) should be administered.

The 16PF parallel forms are deliberately adapted to meet the needs of different populations. Forms A and B are equivalent and are suitable for individuals with a high-school level of education. Forms C and D place a somewhat reduced demand on vocabulary and are also shorter, so that each can be administered in about half an hour. Forms E and F are designed for individuals with low literacy levels. All forms include an intelligence test (Factor B) which provides a brief measure of fluid intelligence, achieving a reduction of the impact of crystallized intelligence, by taking complex relationships among very simple words.

The 16 PF Handbook gives weights for scoring the various second-stratum factors (cf. Boyle & Robertson, 1989; Cattell & Nichols, 1972; Gorsuch & Cattell, 1967; Krug & Johns, 1986). The alignment with the OAB objective test factors is discussed in Cattell and Birkett (1980). The scoring service that IPAT provides automatically calculates the second-stratum scores from the primary scores derived from the answer sheet. Presumably, a principal reason for using second-stratum scores has been the desire of psychologists to score fewer dimensions and to have a simpler, more manageable picture than is given by all 16 primary factors. Psychometrically, the prediction of any kind of behaviour, clinical or normal, from say five second-stratum scores is decidedly poorer (accounting for significantly less variance) than prediction from the full set of primary scores (Mershon & Gorsuch, 1988). The most effective approach is to use primary and secondary scores together in what Cattell has called "depth psychometry" (Cattell, 1987). Since age curves and heritability estimates are now known for these personality factors, just as for intellectual abilities (Cattell et al., 1980), it is now possible to project predictions to some extent into the future.

The Cattellian instruments are widely applied today in clinical diagnosis, forensic psychology, school achievement, vocational counseling and in occupational selection (e.g., see Fisher & Boyle, 1997; Piotrowski & Zalewski, 1993; Watkins et al., 1995). However, due to problems with item transparency and resultant motivational/response distortion (Boyle, 1985), it is more desirable to use objective personality tests rather than subjective questionnaires (Boyle et al., 1995; Boyle & Saklofske, 2004). The arguments for objective test instruments are that they are not readily fakeable, whereas questionnaires can be faked all too easily. However, while we argue for greater use of objective instruments, we also recognize that there have been significant developments in the construction of motivational distortion scales and in trait view theory corrections, which help to minimize the effects of response distortion in questionnaires (see Cattell, 1986a; Cattell & Krug,

1971).

Appropriateness of Assessing Personality via Questionnaires

(1) Wording of Items

It is often falsely assumed that in stratum to get a valid picture of a person's personality via a questionnaire, the person being measured must "know" his or her own personality to start with. If the items on the questionnaire refer only to specific and well-defined behaviours (e.g., "how many books have you read during the last year?" then the respondent need make no inferences at all about the responses. The wording of items is thus very important and calls for the elimination of vague and ambiguous terms. Items presented in operational terms are to be preferred for personality assessment. As soon as one allows judgments of doubtful validity, (such as a question like—"Do others consider you very outgoing?"), then the criticism of subjectivity is to a large extent a valid one.

Composition of Item Pool

At least in the area of normal personality assessment, the current consensus among test designers seems to be to include only items of a general, non-controversial nature, avoiding, for example, controversial items pertaining to religion, sex, and politics, and also minimizing their "social desirability" and susceptibility to other response sets. This recent tendency towards the production of neutral ("unisex") personality inventories (by removing items that differ across sex) makes it well nigh impossible to obtain complete and accurate personality profiles. There are important sex differences in psychological functioning resulting from differences in genes (XX vs. XY chromosomes), brain anatomy (e.g., greater development of the corpus callosum in females leading to more integrated functioning of left and right

cerebral hemispheres in contrast to greater specialization of abilities in males), sex hormone levels (testosterone vs. oestrogen), as well as marked differences in acculturation and social conditioning. Clearly, for comprehensive assessment of individual differences personality, it is important to measure what Cattell has defined as the total "personality sphere" (Boyle & Saklofske, 2004).

Potential Consequences of Test-taking

If the consequences of taking a personality questionnaire are potentially neutral, then the appropriateness of the Q-data method of assessment is probably much higher than when such consequences are significant. Thus, when the consequences could be negative (e.g., admission to a mental institution, or incarceration in prison), or positive (e.g., selection for a job; approval from the therapist; or release from prison or mental institution) then there may be a strong motive (conscious or unconscious) on the part of the respondent to distort his/her responses. In stratum to identify and control for these distortions, many instruments incorporate lie scales (e.g., the *Eysenck Personality Questionnaire*—see Eysenck & Eysenck, 1975), social desirability estimates, faking good and faking bad scales (e.g., 16PF), scales for detecting random responses and scales that identify response sets, and on a deeper theoretical basis, correction by *trait view theory* (Cattell, 1986a; Cattell & Krug, 1971). Trait view corrections show that there is not a *single* "social desirability," but rather, *several* distinct "desirability response tendencies," which impact differentially depending on the particular testing situation.

Other considerations that may influence the degree to which a personality questionnaire is an appropriate instrument in any given situation include (a) the *length* of the instrument (i.e., number of

items); (b) the face validity of items (often some items are so annoying, e.g., "This morning my heart was beating" that the whole questionnaire suffers a loss of credibility and subsequent loss in validity); (c) the format of responses (i.e., forced choice yes/no items; or a Likert-type *scale* of possible responses ranging from, say, "strongly agree" to "strongly disagree").

Standards for Use of Questionnaires in Personality Assessment

Factor Analytic Methodology

Exploratory factor analytic (EFA) methodology has progressed considerably since the publication of Cattell's (1978) treatise (for a detailed discussion of EFA methodological requirements, see Boyle, 1993; Boyle et al., 1995; Boyle & Saklofske, 2004; Child, 1990; Gorsuch, 1983). Over the past three decades, not only has EFA methodology advanced considerably (e.g., inclusion of (1) Cattell's Scree Test; and (2) Promax oblique rotation options within the SPSS statistical package), but also confirmatory factor analysis (CFA), and the more sophisticated structural equation modeling (SEM) that combines factor analysis, multiple regression analysis, and path analysis (implemented via LISREL and EQS statistical packages) have become commonplace. Perhaps the most fundamental drawback in implementing EFA procedures, however, has been (and often remains) undue reliance on inadequate sample sizes, with many EFA studies reported in the social sciences literature being based on 100 or even fewer observations. More than 30 years ago, Cattell (1973, p. 284) had recommended that at least 250 participants are needed to enable accurate factor solutions to be derived. Since then, this prescription itself has been shown to be insufficient. Thus, according to Cuttance (1987, p. 243),

“MacCallum (1985) investigated the process of the exploratory fitting of models in simulated data...for which the true model was known. He found that only about half

of the exploratory searches located the true model...He obtained this limited rate of success...in samples of 300 observations...and his success rate in smaller samples (N=100) was zero....An exploratory analysis of data thus entails the risk of inducing an interpretation founded on the idiosyncracies of individual samples.”

Evidently, much caution must be exercised when undertaking EFA analyses, which tend to promote theory conflation, as opposed to the more scientifically defensible hypothetico-deductive CFA and SEM approaches which enable testing of competing hypotheses and theories.

Standards for Reliability and Validity

When a proper distinction is drawn between dependability, stability, and homogeneity forms of consistency, we nevertheless find some controversy regarding the desirability of the latter. The "older" tradition advocates the highest possible degree of correlation among all items within any one scale as indexed via the Cronbach alpha coefficient on the assumption that this leads to “internal consistency.” In contrast, the “newer” functional testing position (Cattell & Johnson, 1986) argues that optimum (rather than maximum) homogeneity is desirable if breadth of measurement of a construct (factor) is to be obtained (see Boyle, 1991a; Cattell, 1982b, Kline, 1986, for a detailed discussion). Indeed, high item homogeneity could be achieved merely by rewording the same items in many different ways leading to significant “item redundancy.” This point is not a minor issue, since reviewers of psychometric instruments often erroneously point to low homogeneity coefficients as evidence of low overall reliability. A concise summary of consistency coefficients was provided by Cattell (1973, p. 354), along with a detailed

discussion of validity issues (pp. 349-379). These principles are just as important in contemporary psychometric test construction, as they were when formulated by Cattell more than 30 years ago.

Summary and Conclusions

The utility of the 16 PF itself is enhanced by virtue of the fact that it is a *family* of instruments: the 16 PF for adults, the HSPQ for teenagers, the CPQ for children aged 8 to 12 years, the ESPQ for ages 6 to 8 years, and the PSPQ for children below 6 years of age (Butcher & Rouse, 1996; Hofer & Eber, 2002). The objective has been to deal (through the whole age range) with the same factor-analytically derived personality structures (Cattell & Krug, 1986). In most cases, these personality factors have been shown to persist across the family of related instruments, though with some changing expressions and changes of variance. The 16PF family of personality questionnaires has its value in terms of (1) developmental research into personality origins (Barton, 1986c); (2) conceptual insights into the source traits (Boyle, 1990; Cattell & Krug, 1986), ; (3) prediction of criteria over different timespans; and (4) utility of second-stratum Q-data factors (Boyle, 2006; Cattell & Nichols, 1972; Krug & Johns, 1986).

Obtaining both primary and secondary trait scores is the basis of *depth psychometry* (Cattell, 1987), and the simultaneous measurement of both normal and abnormal personality trait dimensions is indispensable in clinical psychological practice, as well as other applications such as occupational selection. As stated above, the CAQ is particularly valuable in clinical practice as it combines a measure of the 16 normal personality trait factors, followed by measures of 12 abnormal personality (psychopathological) trait dimensions. The CAQ has also been used extensively in organizational psychology settings involving selection of

personnel. For example, the Australian Army Psychology Corps has a long history of administering the 16PF and CAQ instruments as part of its routine psychological assessment procedures.

Questionnaires can only be properly appraised within the perspective of the three media of measurement (L-data, Q-data, and T-data). Subjective measures are subject to perceptual distortion (L-data and Q-data), whereas objective measures involve actual tests (T-data). The empirical evidence suggests that L-data and Q-data factors deal with the same personality source traits, whereas second-stratum personality factors in Q-data align with first-stratum T-data factors as measured via the *Objective Analytic Battery* (OAB—Cattell & Birkett, 1980; Cattell & Schuerger, 1978; Schuerger, 1986). In light of the serious validity problems associated with item transparency and motivational/response distortion of L-data and Q-data instruments (Boyle, 1985), and despite the current popularity of personality questionnaires (as perusal of the *Buros Mental Measurements Yearbooks* indicates), it is to be hoped that in the future, use of objective personality (T-data) instruments will become the “gold standard.” The plethora of “personality tests” has literally exploded in recent years. Virtually all of these are simple rating scales (subjective ratings of others or subjective self ratings). Aside from response sets, and superficial reporting, a major problem with rating scales of personality/motivation is that they depend upon transparent, face valid items. Item transparency is associated with problematic response or motivational distortion so that most current personality assessment is based on flawed methodology. Correction scales can go only so far, and in some cases (e.g., K-scale in MMPI) application of the correction may just as often produce less accurate results.

In summary, what is needed are truly *objective interactive personality tests* (implemented via

computer with stimulus items individualized for each respondent). While Cattell and Warburton produced a compendium of over 2000 objective personality tests as long ago as 1967, aside from the innovative *Objective-Analytic Test Battery* which includes such T-data tests (see Cattell & Schuerger, 1978; Schuerger, 1986), little effort has been devoted subsequently to the construction of truly objective personality tests. Regrettably, virtually all new personality instruments constructed have been based on subjective L-data or Q-data measurement approaches. Merely eliciting subjective responses to questions in rating scales and questionnaires, rather than observing actual behaviours in actual (T-data) test situations, remains a major ongoing difficulty for the scientific advancement of personality assessment (cf. Cattell, 1979, p. 123). Clearly, the field of personality assessment needs to be transformed out of its present subjective measurement quandary and lifted onto an altogether more technologically sophisticated level of objective-interactive testing as advocated by Boyle (2006) in his Doctor of Science thesis.

References

- Barton, K. (1985a). A nine parameter model for psychological assessment. Journal of Personality Assessment, 49, 399-405.
- Barton, K. (1985b). The central trait-state scales. A kit of 20 subtests measuring five central personality dimensions as traits and states, with equivalent forms. Champaign, IL: Institute for Personality and Ability Testing.
- Barton, K. (1986a). Assessment viewed from an experimental perspective: A marriage of practitioner and researcher. Journal of Social Behavior and Personality, 1, 61-75.
- Barton, K. (1986b). Measuring emotional states and temporary role adoptions. In R. B. Cattell & R. C. Johnson (Eds.), Functional psychological testing: Principles and instruments (pp. 334-347).

New York: Brunner/Mazel.

- Barton, K. (1986c). Personality assessment by questionnaire. In R. B. Cattell & R. C. Johnson (Eds.), Functional psychological testing: Principles and instruments (pp. 237-259). New York: Brunner/Mazel.
- Barton, K., & Cattell, R. B. (1975). An investigation of the common factor space of some well-known questionnaire scales: The Eysenck EPI, the Comrey Scales and the IPAT Central Trait-State Kit (CST). Journal of Multivariate Experimental Personality and Clinical Psychology, 1, 268-277.
- Barton, K., & Cattell, R. B. (1981). The Central Trait-State Kit (CTS): Experimental version. Champaign, IL: Institute for Personality and Ability Testing.
- Barton, K., Dielman T. E., & Cattell, R. B. (1986). Prediction of objective child motivation test scores from parents' reports of child-rearing practices. Psychological Reports, 59, 343-352.
- Barton, K., & Dreger, R. M. (1986). Prediction of marital roles from normal and pathological dimensions of personality: 16PF and MMPI. Psychological Reports, 59, 459-468.
- Barton, K., & Flocchini, S. (1985). P-Technique factor analysis and the construct validity of emotional state scales. Multivariate Experimental Clinical Research, 7, 61-67.
- Barton, K., & Wood, S. (1993). Psychological assessment from clinical research perspectives: Some empirical evidence for stereotypes. Journal of Social Behavior and Personality, 8, 27-42.
- Birkett-Cattell, H. (1989). The 16PF: Personality in depth. Champaign, IL: Institute for Personality and Ability Testing.
- Boyle, G. J. (1983). Critical review of state-trait curiosity test development. Motivation and Emotion, 7, 377-397.
- Boyle, G. J. (1985). Self-report measures of depression: Some psychometric considerations. British Journal of Clinical Psychology, 24, 45-59.

- Boyle, G. J. (1986). Intermodality superfactors in the Sixteen Personality Factor Questionnaire, Eight State Battery and Objective Motivation Analysis Test. Personality and Individual Differences, 7, 583-586.
- Boyle, G. J. (1987a). Evidence of typological mood states from change-score (dR)-factoring of the Clinical Analysis Questionnaire. Psychologische Beiträge, 29, 290-299.
- Boyle, G. J. (1987b). Psychopathological depression superfactors in the Clinical Analysis Questionnaire. Personality and Individual Differences, 8, 609-614.
- Boyle, G. J. (1988). Elucidation of motivation structure by dynamic calculus. In J. R. Nesselroade & R. B. Cattell (Eds.), Handbook of multivariate experimental psychology (2nd ed.) (pp. 737-787). New York: Plenum.
- Boyle, G. J. (1989a). Breadth-depth or state-trait curiosity? A factor analysis of state-trait curiosity and state anxiety scales. Personality and Individual Differences, 10, 175-183.
- Boyle, G. J. (1989b). Central dynamic traits measured in the School Motivation Analysis Test. Multivariate Experimental Clinical Research, 9, 11-26.
- Boyle, G. J. (1989c). Children's Motivation Analysis Test (CMAT): Normative data. Psychological Reports, 65, 920-922.
- Boyle, G. J. (1989d). Factor structure of the Differential Emotions Scale and the Eight State Questionnaire revisited. Irish Journal of Psychology, 10, 56-66.
- Boyle, G. J. (1989e). Re-examination of the major personality-type factors in the Cattell, Comrey and Eysenck scales: Were the factor solutions by Noller et al. optimal? Personality and Individual Differences, 10, 1289-1299.
- Boyle, G. J. (1989f). Review of R. B. Cattell & R. C. Johnson's (1986) "Functional psychological testing: Principles and instruments." Multivariate Experimental Clinical Research, 9, 41-43.
- Boyle, G. J. (1990). A review of the factor structure of the Sixteen Personality Factor

- Questionnaire and the Clinical Analysis Questionnaire. Psychological Test Bulletin, 3, 40-45.
- Boyle, G. J. (1991a). Experimental psychology does require a multivariate perspective. Contemporary Psychology, 36, 350-351.
- Boyle, G. J. (1991b). Item analysis of the subscales in the Eight State Questionnaire (8SQ): Exploratory and confirmatory factor analyses. Multivariate Experimental Clinical Research, 10, 37-65.
- Boyle, G. J. (1993). Special Review: Evaluation of the exploratory factor analysis programs provided in SPSSX and SPSS/PC+. Multivariate Experimental Clinical Research, 10, 129-135.
- Boyle, G. J. (2006). Scientific analysis of personality and individual differences. D.Sc. Thesis. St. Lucia: University of Queensland.
- Boyle, G. J., & Cattell, R. B. (1984). Proof of situational sensitivity of mood states and dynamic traits to disturbing stimuli. Personality and Individual Differences, 5, 541-548.
- Boyle, G. J., & Cattell, R. B. (1987). A first survey of the similarity of personality and motivation prediction of 'in situ' and experimentally controlled learning, by structured learning theory. Australian Psychologist, 22, 189-196.
- Boyle, G. J., & Comer, P. G. (1990). Personality characteristics of direct-service personnel in community residential units. Australia and New Zealand Journal of Developmental Disabilities, 16, 125-131.
- Boyle, G. J., & Langley, P. D. (1989). Elementary statistical methods: For students of psychology, education and the social sciences. Sydney: Pergamon.
- Boyle, G. J., Ortet, G., & Ibáñez, M. I. (2001). Evaluación de la personalidad y la inteligencia: Una perspectiva cattelliana (Evaluation of personality and intelligence: A Cattellian perspective). Universitas Tarraconensis Revista de Psicología, 23, 73-92.

- Boyle, G. J., & Robertson, J. M. (1989). Anomaly in equation for calculating 16PF second-order factor QIII. Personality and Individual Differences, 10, 1007-1008.
- Boyle, G. J., & Saklofske, D H. (2004). (Eds.), Editors' Introduction. Sage benchmarks in psychology: The psychology of individual differences, Vol. 1: Intelligence. Vol. 2: Personality. Vol. 3: Cognition, emotion and conation. Vol. 4: Clinical and applied research. London: Sage.
- Boyle, G. J., & Smári, J. (1997). De fem stora och personlighetspsykologins matningsproblem (The big five and measurement problems in personality psychology). Nordisk Psykologi (Nordic Psychology), 49, 12-21.
- Boyle, G. J., & Smári, J. (1998). Statiska femfaktorpersonlighets-modeller-Svar till Engvik (Static five-factor models of personality: A reply to Engvik). Nordisk Psykologi (Nordic Psychology), 50, 216-222.
- Boyle, G. J., & Smári, J. (2002). Vers une simplification du modèle cattellien de la personnalité (Towards a simplification of the Cattellian model of personality). Bulletin de Psychologie, 55, 635-643.
- Boyle, G. J., Stankov, L., & Cattell, R. B. (1995). Measurement and statistical models in the study of personality and intelligence. In D. H. Saklofske & M. Zeidner (Eds.), International handbook of personality and intelligence (pp. 417-446). New York: Plenum.
- Boyle, G. J., Stanley, G. V., & Start, K. B. (1985). Canonical/redundancy analyses of the Sixteen Personality Factor Questionnaire, the Motivation Analysis Test, and the Eight State Questionnaire. Multivariate Experimental Clinical Research, 7, 113-122.
- Boyle, G. J., & Start, K. B. (1988). A first delineation of higher-order factors in the Children's Motivation Analysis Test (CMAT). Psychologische Beiträge, 30, 556-567.
- Boyle, G. J., Start, K. B., & Hall, E. J. (1988). Comparison of Australian and American normative data for the School Motivation Analysis Test. Psychological Test Bulletin, 1,

24-27.

- Butcher, J.N. & Rouse, S.V. (1996). Personality: Individual differences and clinical assessment. Annual Review of Psychology, *47*, 87-111.
- Campbell, D. P., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. Psychological Bulletin, *56*, 91-105.
- Cattell, H. E. P. (2001). The Sixteen Personality Factor (16PF) Questionnaire. In W. I. Dorfman & M. Hersen (Eds), Understanding psychological assessment (pp. 187-215). Dordrecht, The Netherlands: Kluwer.
- Cattell, H. E.P. (2004). The Sixteen Personality Factor (16PF) questionnaire. In M. J. Hilsenroth & D. L. Segal. (Eds.), Comprehensive handbook of psychological assessment (Vol. 2): Personality assessment (pp. 39-49). Hoboken, NJ: Wiley.
- Cattell, H. E. P, & Schuerger, J. M. (2003). Essentials of 16PF assessment. Hoboken, NJ: Wiley.
- Cattell, R. B. (1973). Personality and mood by questionnaire. San Francisco: Jossey-Bass.
- Cattell, R. B. (1978). The scientific use of factor analysis in behavioral and life sciences. New York: Plenum.
- Cattell, R. B. (1979). Personality and learning theory, Vol. 1.: The structure of personality in its environment. New York: Springer.
- Cattell, R. B. (1982a). The clinical use of difference scores: Some psychometric problems. Multivariate Experimental Clinical Research, *6*, 87-98.
- Cattell, R. B. (1982b). The psychometry of objective motivation measurement: A response to the critique of Cooper and Kline. British Journal of Educational Psychology, *52*, 234-241.
- Cattell, R. B. (1983). Structured personality-learning theory: A wholistic multivariate research approach. New York: Praeger.
- Cattell, R. B. (1985). Human motivation and the dynamic calculus. New York: Praeger.

- Cattell, R. B. (1986a). Dodging the third error source: Psychological interpretation and use of given scores. In R. B. Cattell & R. C. Johnson (Eds.), Functional psychological testing: Principles and instruments (pp. 496-543). New York: Brunner/Mazel.
- Cattell, R. B. (1986b). General principles across the media of assessment. In R. B. Cattell & R. C. Johnson (Eds.), Functional psychological testing: Principles and instruments (pp. 15-32). New York: Brunner/Mazel.
- Cattell, R. B. (1986c). Selecting, administering, scoring, recording, and using tests in assessment. In R. B. Cattell & R. C. Johnson (Eds.), (1986). Functional psychological testing: Principles and instruments (pp. 105-126). New York: Brunner/Mazel.
- Cattell, R. B. (1986d). Structured tests and functional diagnoses. In R. B. Cattell & R. C. Johnson (Eds.), Functional psychological testing: Principles and instruments (pp. 3-14). New York: Brunner/Mazel.
- Cattell, R. B. (1986e). The actual trait, state, and situation structures important in functional testing. In R. B. Cattell & R. C. Johnson (Eds.), Functional Psychological Testing (pp. 33-53). New York: Brunner/Mazel.
- Cattell, R. B. (1986f). The psychometric properties of tests: Consistency, validity, and efficiency. In R. B. Cattell & R. C. Johnson (Eds.), Functional psychological testing: Principles and instruments (pp. 54-78). New York: Brunner/Mazel.
- Cattell, R. B. (1986g). The 16 PF personality structure and Dr. Eysenck. Journal of Social Behavior and Personality, 1, 153-160.
- Cattell, R. B. (1987). Psychotherapy by structured learning theory. New York: Springer.
- Cattell, R. B. (1992a). Human motivation objectively, experimentally analysed. British Journal of Medical Psychology, 65, 237-243.
- Cattell, R. B. (1992b). Superseding the motivational distortion scale. Psychological Reports, 70,

499-502.

Cattell, R. B. (1994). A cross-validation of primary personality structure in the 16 P.F. by two parcelled factor analyses. Multivariate Experimental Clinical Research, 10, 181-190.

Cattell, R. B. (1995). The fallacy of five factors in the personality sphere. The Psychologist, May, 207-208.

Cattell, R. B. (1996). Personality and structured learning. European Review of Applied Psychology, 46, 73-75.

Cattell, R. B., & Birkett, H. (1980). The known personality factors aligned between first-order T-data and second-order Q-data factors, with new evidence on the inhibitory control, independence and regression traits. Personality and Individual Differences, 1, 229-238.

Cattell, R. B., Boyle, G. J., & Chant, D. (2002). The enriched behavioral prediction equation and its impact on structured learning and the dynamic calculus. Psychological Review, 109, 202-205.

Cattell, R. B., & Cattell, M. D. (1975). Handbook for the Junior and Senior High School Personality Questionnaire. Champaign, IL: Institute for Personality and Ability Testing.

Cattell, R. B., & Cattell, A. K. S. (1977). Measuring intelligence with the culture fair tests. Champaign, IL: Institute for Personality and Ability Testing.

Cattell, R. B., & Cattell, H. E. P. (1995). Personality structure and the new fifth edition of the 16PF. Educational and Psychological Measurement, 55, 926-937.

Cattell, R. B., Danko, G., Cattell, H. B., & Raymond, J. (1983). A cross cultural study of primary personality factor structure in the preparation of the Hawaiian HSPQ. Multivariate Experimental Clinical Research, 7, 1-23.

Cattell, R. B., & Dreger, R. M. (Eds.). (1978). Handbook of modern personality theory. New York: Wiley.

Cattell, R. B., & Horn, J. L. (1982). Whimsy and misunderstanding of Gf-Gc theory: A comment

- on Guilford. Psychological Bulletin, 91, 621-633.
- Cattell, R. B., & Johnson, R. C. (1986). (Eds.), Functional psychological testing: Principles and instruments. New York: Brunner/Mazel.
- Cattell, R. B., & Kameoka, V. A. (1985). Psychological states measured in the Clinical Analysis Questionnaire (CAQ). Multivariate Experimental Clinical Research, 7, 69-87.
- Cattell, R. B., & Kline, P. (1977). The scientific analysis of personality and motivation. New York: Academic.
- Cattell, R. B., & Krug, S. E. (1971). A test of the trait-view theory of distortion in measurement of personality questionnaire. Educational and Psychological Measurement, 31, 721-734.
- Cattell, R. B., & Krug, S. E. (1986). The number of factors in the 16PF: A review of the evidence with special emphasis on methodological problems. Educational and Psychological Measurement, 46, 509-522.
- Cattell, R. B., & Nesselroade, J. R. (1988). (Eds.), Handbook of multivariate experimental psychology (2nd ed.). New York: Plenum.
- Cattell, R. B., & Nichols, K. E. (1972). An improved definition, from 10 researches, of second-order personality factors in Q-Data (with cross-cultural checks). Journal of Social Psychology, 86, 187-203.
- Cattell, R. B., Rao, D. C., Schuerger, J. M., & Vaughan, D. S. (1980). Unitary personality traits analyzed for heritability. Human Heredity, 31, 261-275.
- Cattell, R. B., & Scheier, I. (1961). The meaning and measurement of neuroticism and anxiety. New York: Ronald.
- Cattell, R. B., & Schuerger, J. M. (1978). Personality theory in action: Handbook for the Objective-Analytic (O-A) Test Kit. Champaign, IL: Institute for Personality and Ability Testing.
- Cattell, R. B., & Warburton, F. W. (1967). Objective personality and motivation tests: A

- theoretical introduction and practical compendium. Champaign, IL: University of Illinois Press.
- Child, D. (1990). The essentials of factor analysis (2nd ed.). London: Cassell.
- Coan, R. W., & Cattell, R. B. (1959). The development of the Early School Personality Questionnaire. Journal of Experimental Education, 28, 143-152.
- Comrey, A.L. (1980). Handbook of interpretations for the Comrey Personality Scales. San Diego, CA: Educational and Industrial Testing Service.
- Conn, S. R. & Rieke, M. L. (1994). Technical Manual for the 16 P.F.(5th ed.) Champaign, IL, Institute for Personality and Ability Testing.
- Curran, J. P., & Cattell, R. B. (1976). Manual for the Eight State Questionnaire. Champaign, IL, Institute for Personality and Ability Testing.
- Cuttance, P. (1987). Issues and problems in the application of structural equation models. In P. Cuttance, & R. Ecob (Eds.), Structural modeling by example: Applications in educational, sociological, and behavioral research (pp. 241-279). Cambridge, UK: Cambridge University Press.
- Dreger, R. M., Lichtenstein, D., & Cattell, R. B. (1995). Manual for the Experimental Edition of the Personality Questionnaire for Preschool Children Form A. Journal of Social Behavior and Personality, 10 (Suppl), 1-50.
- Eysenck, H. J. (1984). Cattell and the theory of personality. Multivariate Behavioral Research, 19, 323-336.
- Eysenck, H. J. (1988). Dimensions of personality. New Brunswick, NJ: Transaction Publishers.
- Eysenck, H. J. (1994a). Normality-abnormality and the three-factor model of personality. In S. Strack & M. Lorr (1994). (Eds.), Differentiating normal and abnormal personality (pp. 3-25). New York: Springer.
- Eysenck, H. J. (1994b). Personality and intelligence: Psychometric and experimental

- approaches. In R. J. Sternberg & P. Ruzgis (Eds.), Personality and intelligence (pp. 3-31). New York: Cambridge University Press.
- Eysenck, H. J. (1994c). Personality: Biological foundations. In P. A. Vernon (1994). (Ed.), The neuropsychology of individual differences (pp. 151-207). San Diego, CA: Academic.
- Eysenck, H. J. (1997). Personality and experimental psychology: The unification of psychology and the possibility of a paradigm. Journal of Personality and Social Psychology, 73, 1224-1237.
- Eysenck, H. J., & Eysenck, S. B. G. (1975). Manual of the Eysenck Personality Questionnaire (junior and adult). London: Hodder & Stoughton.
- Eysenck, H. J., & Eysenck, M. W. (1985). Personality and individual differences: A natural science approach. New York: Plenum.
- Fisher, C. D., & Boyle, G. J. (1997). Personality and employee selection: Credibility regained. Asia Pacific Journal of Human Resources, 35, 26-40.
- Glass, G. V., & Stanley, J. C. (1970). Statistical methods in education and psychology. Englewood Cliffs, NJ: Prentice-Hall.
- Gorsuch, R. L., & Cattell, R. B. (1967). Second stratum personality factors defined in the questionnaire realm by the 16PF. Multivariate Behavioral Research, 2, 211-224.
- Gorsuch, R. L. (1983). Factor analysis (2nd ed.). Hillsdale, NJ: Erlbaum.
- Haggbloom, S. J., Warnick, R., Warnick, J. E., Jones, V. K., Yarbrough, G. L., Russell, T. M., Borecky, C. M., McGahhey, R., Powell III, J. L., Beavers, J., & Monte, E. (2002). The 100 most eminent psychologists of the 20th century. Review of General Psychology, 6, 139-152.
- Hakstian, A. R., & Cattell, R. B. (1982). Manual for the Comprehensive Ability Battery. Champaign, IL: Institute for Personality and Ability Testing.

Hofer, S.M., Horn, J.L., & Eber, H.W. (1997). A robust five-factor structure of the 16PF:

Strong evidence from independent rotation and confirmatory factorial invariance procedures. Personality and Individual Differences, 23, 247-269.

Johnson, R. C. (1986). Personality assessment by observers in normal and psychiatric data. In R. B.

Cattell & R. C. Johnson (Eds.), Functional psychological testing: Principles and instruments (pp. 208-236). New York: Brunner/Mazel.

Johnson, R. C., Porteus, B. D., & Cattell, R. B. (1986). The wider scientific and social aspects of

psychological testing. In R. B. Cattell & R. C. Johnson (Eds.), Functional psychological testing: Principles and instruments (pp. 142-165). New York: Brunner/Mazel.

Kline, P. (1986). A handbook of test construction: Introduction to psychometric design. New York: Methuen.

Krug, S. E. (1980). Clinical Analysis Questionnaire Manual. Champaign, IL: Institute for Personality and Ability Testing.

Krug, S. E. (1981). Interpreting 16PF profile patterns. Champaign, IL, Institute for Personality and Ability Testing.

Krug, S. E., & Johns, E. F. (1986). A large scale cross-validation of second-order personality structure defined by the 16PF. Psychological Reports, 59, 683-693.

Lichtenstein, D., Dreger, R. M., & Cattell, R. B. (1986). Factor structure and standardization of the Preschool Personality Questionnaire. Journal of Social Behavior and Personality, 1, 165-182.

MacCallum, R. (1985). Some problems in the process of model modification in covariance structure modeling. Paper presented to the European Meeting of the Psychonomic Society, Cambridge, UK.

Mershon, B., & Gorsuch, R. L. (1988). Number of factors in the personality sphere: Does increase in factors increase predictability of real-life criteria? Journal of Personality and

Social Psychology, 55, 675-680.

Piotrowski, C., & Zalewski, C. (1993). Training in psychodiagnostic testing in APA-approved

Psy.D. and Ph.D. clinical psychology programs. Journal of Personality Assessment, 61, 394-405.

Porter, R. B., & Cattell, R. B. (1985). Handbook for the Children's Personality Questionnaire (CPQ). Champaign, IL: Institute for Personality and Ability Testing.

Roberts, B. W., Walton, K. E., Viechtbauer, W. (2006a). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies.

Psychological Bulletin, 132, 1-25.

Roberts, B. W., Walton, K. E., Viechtbauer, W. (2006b). Personality traits change in adulthood:

Reply to Costa and McCrae (2006). Psychological Bulletin, 132, 29-32.

Schuerger, J. M. (1986). Personality assessment by objective tests. In R. B. Cattell & R. C.

Johnson (Eds.), Functional psychological testing: Principles and instruments (pp. 260-287). New York: Brunner/Mazel.

Smith, B. D. (1988). Personality: Multivariate systems theory and research. In J. R. Nesselrode

& R. B. Cattell (Eds.), Handbook of multivariate experimental psychology (2nd ed.). New York: Plenum.

Sweney, A. R., Anton, & Cattell, R. B. (1986). Evaluating motivation structure, conflict, and

adjustment. In R. B. Cattell & R. C. Johnson (Eds.), Functional psychological testing:

Principles and instruments (pp. 288-315). New York: Brunner/Mazel.

Watkins, C.E., Campbell, V. L., Nieberding, R., & Hallmark, R. (1995). Contemporary practice of

psychological assessment by clinical psychologists. Professional Psychology: Research and Practice, 26, 54-60.

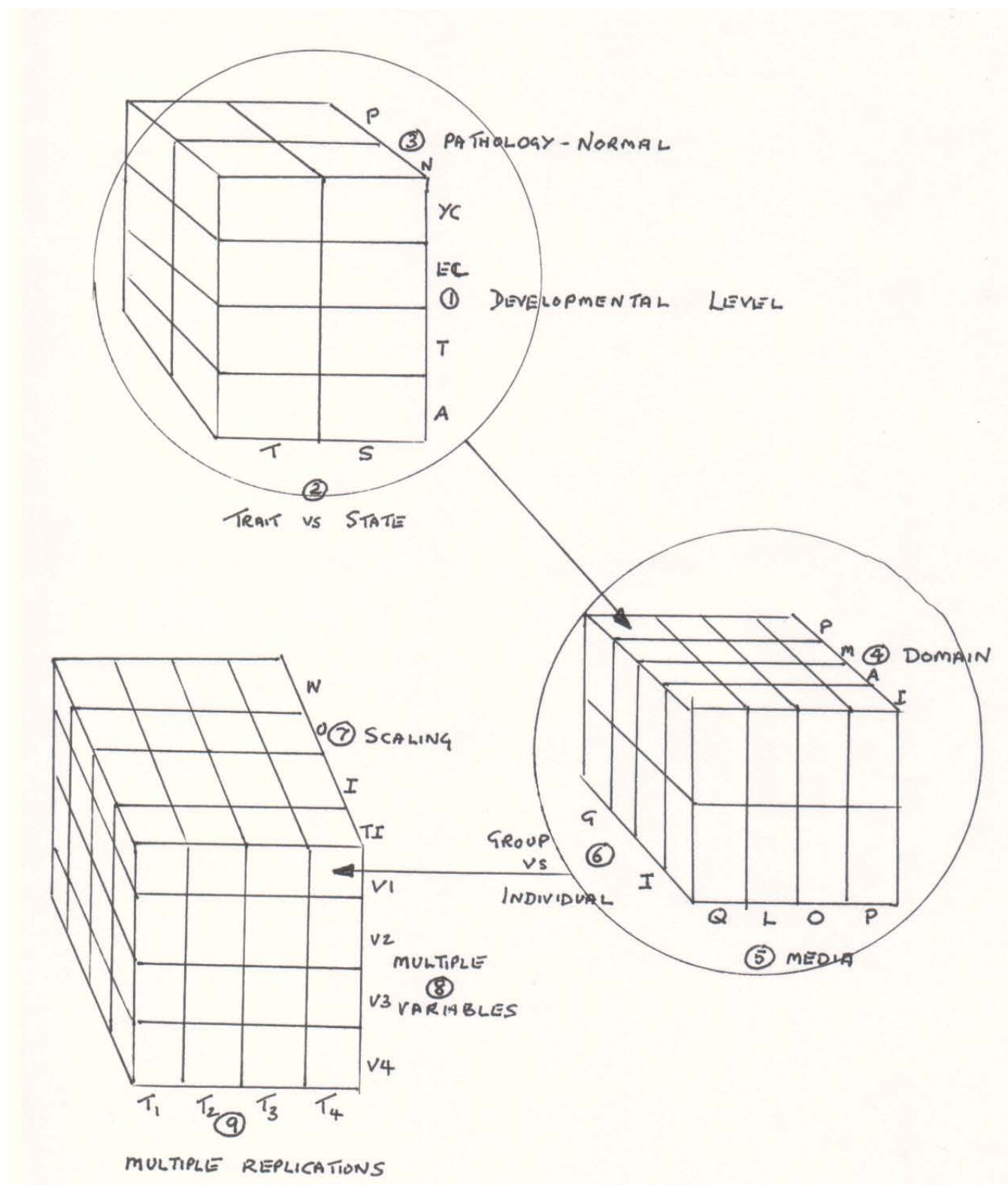


Figure 1: The 9 Parameter Model